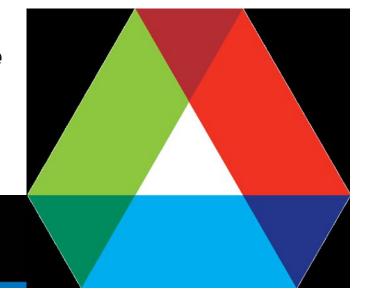


# Thoughts on Regulatory Requirements for CO<sub>2</sub> Injection

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# **Topics**

- How should CO<sub>2</sub> be classified?
- What should we call the process of injecting CO<sub>2</sub>?
- If I were building a regulatory program, what elements would I want to include?
- If carbon geosequestration becomes a large-scale reality, how can state, federal, and international agencies scale up to handle the tens of thousands of new injection wells?



# What Is CO<sub>2</sub>?

- Different properties and impacts depending on time, place, and application
  - Natural substance with negative impact on atmosphere and climate
  - Important substance/raw material for plant growth
  - Valuable aid to hydrocarbon production
  - Commodity for trading
  - Waste
  - Component of popular beverages



# What is CO<sub>2</sub> - continued

- The legal and perception implications seem to be driving the way in which different groups are trying to characterize CO<sub>2</sub>
- We should not try to be too clever about naming and defining activities
  - The public is not stupid!
  - Attempts to disguise reality will not engender confidence
- Any regulatory scheme that emphasizes the negative properties of CO<sub>2</sub> will impede society's ability to manage/store/sequester carbon



# What Should We Call the Process for Injecting CO<sub>2</sub> Underground?

- Traditionally called "sequestration"
- More recent efforts, concerned with perception and legal implications, have shifted to the term "storage"
  - How long will the material be stored?
  - Does society have any serious intention to recover or reclaim the CO<sub>2</sub>?
- How does injection for enhanced recovery equate to storage?
- I prefer the term "sequestration" or more specifically, "geosequestration" or "geological sequestration"



# What Are Some Concerns About CO<sub>2</sub> Geologic Sequestration?

- Regulators and injectors have limited experience with CO<sub>2</sub> geologic sequestration. Challenges include:
  - Lower fluid density = greater buoyancy of injectate
  - CO<sub>2</sub> reacts with water to form acid
  - What other constituents will be acceptable in the CO<sub>2</sub> injectate?
  - Geochemical changes
    - Could other chemicals be generated in the formations and in ground water as a result of CO<sub>2</sub> injection?
  - Damaging effects on cement and metal
  - Keeping CO<sub>2</sub> in desired formations for a sustained time
    - How much CO<sub>2</sub> escape is acceptable?



# What Should Be Part of a Regulatory Program for CO<sub>2</sub> Geosequestration?

### Siting

- Geology of injection formation and overlying formations
- Reservoir pressure profiles and other characteristics
- Appropriate area of review (well bores, faults, or vertical conduits)

#### Well construction

- Strength and metallurgy of pipes, casing
- Number of casing strings
- Type and vertical extent of cement
- Assurance of good cement bond

### Operations

- Maximum injection pressure (above or below fracture pressure)
- Injection rate and volume
- Interactions between injectate, formations, and formation fluids
- Injection for sequestration/storage vs. use for EOR



# Additional Regulatory Issues for Geosequestration

### Monitoring

- Mechanical integrity testing
- How to monitor sequestration area

#### Closure

- Plugging and securing
- Long term issues
- Financial assurance

### Legal/Policy

- Ownership interests in wells, pore spaces, and fluids
- Long-term maintenance and liability
- Length of time that CO<sub>2</sub> must be sequestered underground
- Credit for CO<sub>2</sub> capture/removal from atmosphere



# How Can Society Manage the Massive Scope of the Proposed CO<sub>2</sub> Geologic Sequestration?

- If society is serious about the benefits of removing CO<sub>2</sub> from the atmosphere, it must accept some potential costs/risks of placing that CO<sub>2</sub> somewhere
  - Education of the public will be critical to manage the vast misinformation that will circulate
    - Start very soon with school children and let them become familiar with the issues, challenges, and options for solutions
  - The public will become more focused on global warming and carbon control following the May 24 release of the new Al Gore movie "An Inconvenient Truth"



# Regulatory Program Development

- Build on existing UIC program
  - Consider whether CO<sub>2</sub> injection wells can fit appropriately into existing well classes or whether new well class is needed
  - Provide for guidance and training to regulators with expected delegation of permitting authority from federal to state agencies
- Need to start out slowly and carefully, but be prepared to institute mechanisms to allow rapid permitting of large number of similar projects
- Recognize that the types of controls and requirements used when evaluating and permitting the first 10, 50, or 100 injection wells will not be practical or appropriate for a later time when hundreds to thousands of wells will be permitted per year
  - Example: permitting of coal bed methane wells in Powder River Basin

